

Your Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Year 9**

**Ecosystems**

**Field Manual**



**Choose an appropriate site around the school that you will analyse over the next couple of lessons. Ensure that you do not damage any part of this site in your studies.**

**Site Description:**

**Site map/sketch:**

**BIOTIC FACTORS:**

Write down four different species of flora and four different species of fauna that you’ve observed:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**ABIOTIC FACTORS:**

List at least 8 different abiotic factors that may have an influence on the biotic factors in this environment:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

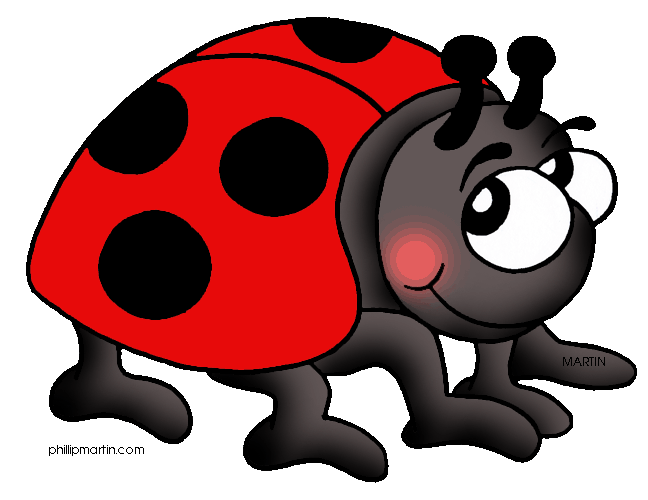
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**FOOD CHAINS, FOOD WEBS AND FOOD PYRAMIDS:**

1. Choose at least four organisms from your site and draw a likely food chain and food pyramid in the space provided below.
2. Choose at least 12 organisms from your site and draw a likely food web in the space provided below. Make sure the arrows are going in the right direction!



**From your list, identify two organisms (one plant and one animal) and complete the following diagrams on the next two pages:**

**Organism 1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Related abiotic factor:

Related abiotic factor:

Related abiotic factor:

Eaten by:

Feeds on:

Animal/Plant:

Habitat:

Role in Energy Flow:

Adaptations:

**Notes/Photograph/Sketch**

**Organism 2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**ABIOTIC FACTORS:**

Related abiotic factor:

Related abiotic factor:

Related abiotic factor:

Eaten by:

Feeds on:

Animal/Plant:

Habitat:

Role in Energy Flow:

Adaptations:

**Notes/Photograph/Sketch**

Both in soil and water, pH affects plant growth. Each species grows best at a certain pH. Any departure from the optimum pH will have an adverse effect and may kill the plant. Plants such as azalea, camellia, rhododendron and oak only grow in acid soils (pH range 4.0 – 6.5). These plants are now known to be intolerant of calcium ions in the soil and may be known as **caclifuges** (“lime-haters”). Plants that live in limestone soils (pH range 7.5 – 9.0) are known as **calcicoles** (“lime-tolerant”).

**Complete Activity 5.1: Measuring Abiotic Factors on page 184 in your textbook. Complete your answers in the spaces provided below.**

|  |  |  |
| --- | --- | --- |
| **ABIOTIC FACTOR** | **ENVIRONMENT A** | **ENVIRONMENT B** |
| **Water Temperature (°C)** |  |  |
| **Soil Temperature (°C)** |  |  |
| **Water pH** |  |  |
| **Water Salinity** |  |  |
| **Soil pH** |  |  |

1. a) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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2. **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**AIR POLLUTION:**

It is often difficult to measure air pollution in the field, as sophisticated equipment and long-term monitoring are needed to obtain worthwhile data. One way to overcome this problem is to choose an aspect of air pollution which can easily be measured and combine it with secondary data available on the Internet.

Particulate pollution (i.e. soot) adhering to tree bark can rapidly be measured using nothing more complicated than sticky tape. Immediately this introduces a number of variables that could be investigated, such as the direction in which the bark is facing, its height off the ground and its distance from a point source of pollution.

**Procedure:**

Press the sticky side of a 2cm length of tape firmly onto the bark of the tree, leave for 10 seconds, and then remove it. Soot and other particles from the air will have adhered to the tape, along with debris such as loose bark and moss from the tree. Take two samples of particles at 1 metre above the base of the tree. Attach them to your field manual in the spaces provided below.

**Analysing Results:**

The sticky tape on the slides can be examined under the microscope. Make mini-quadrats by photocopying graph paper onto acetates. Lay an acetate grid over the pollution sample (sticky tape). Use random co-ordinates to locate a quadrat. Estimate and record the percentage frequency of black particulates in the chosen quadrat.

Repeat this estimation of particulates between 15 – 20 times for different quadrats, and calculate an average percentage covert of particulates for the sample site. Only soot particles should be recorded, ignore moss and bark. A hand lens may be useful.

**MEASURING SOIL HARDNESS**

Soil hardness (or soil compaction) can be measured in the field by using a metal stake or pin. These can easily be made by using knitting needles. Hold the stake out at arm’s length above the centre of the quadrant and let it fall through your fingers. Measure the depth of entry into the soil. This may seem unscientific, but it really does work if pupils take care to let the stake fall from the same height above the quadrat each time.

Alternatively, after a dry period when the soil is hard, apply uniform pressure to the stake at each measuring site and measure the depth it reaches into the soil. Clean the stake of soil before it is used for the next measurement.

**MAKE YOUR OWN SOIL PIN**

A knitting needle is long enough to measure most soil depths which will be found. It may be useful to use indelible ink to mark depths on the side of the needle.

Select five different sites around your selected ecosystem and measure the soil hardness.

**Site 1:**

General description of location: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Site 2:**

General description of location: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Site 3:**

General description of location: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Site 4:**

General description of location: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Site 5:**

General description of location: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**SAMPLES OF SOIL**

Use sticky tape to take a sample of soil from each site and attach below:

|  |  |  |
| --- | --- | --- |
| **Site 1** | **Site 2** | **Site 3** |
| **Site 4** | **Site 5** |  |

**QUADRATS:**

A quadrat is usually a square shaped study area, used to determine the abundance of an organism. Quadrat sites are either chosen in a random fashion or placed in a series along a grid or a transect line. Using a quadrat is relatively simple; just count the number of species inside it!

**ACTIVITY A: QUADRAT CLASSROOM ACTIVITY (whole class activity)**

*Materials (per class):*

For one class, approximately 400 paperclips in 7 different colours. Each colour represents a different species, for example:

Mussels – 165 red paper clips

*\*\*\* The colours of the paper clips may vary depending on what is available.*

*Your teacher will assist you in making changes if necessary.*

Sea snails – 100 yellow paper clips

Sea urchins – 70 pink paper clips

Sea stars – 30 blue paper clips

Sea cucumbers – 20 white paper clips

Sea lettuces – 10 green paper clips

Abalone – 5 black paper clips

6m marking tape (for transect line)

Three x 1m quadrats

*Method:*

1. Lay the marking tape across the floor of the classroom. Identify to the students that this is a transect line (they will learn about these in future activities).
2. Separate the masking tape into 1m sections – label these sections 1 – 6.
3. Randomly sprinkle all the paper clips along one side of the transect line (within 25cm or so of the line). NOTE: for this classroom activity we are just going to use one side of the transect line to simply the procedure. When you go out into the field, you will conduct counts on both sides of the transect line).
4. Write the numbers 1-6 on a piece of paper, cut them up, turn them over and mix them up.
5. Choose three numbers from the pile – these will each be the random sample sites on the transect line that you will set up a quadrat over.
6. Place the quadrat over the paper clips in each of the three sections that have been identified.
7. Count the number and colour of each paper clip that is found within each quadrat. Place this information in the table below:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Quadrat A - \_\_\_\_\_\_m** | **Quadrat B - \_\_\_\_\_\_\_\_m** | **Quadrat C - \_\_\_\_\_\_\_\_m** |
| Mussels |  |  |  |
| Sea snails |  |  |  |
| Sea urchins |  |  |  |
| Sea star |  |  |  |
| Sea cucumbers |  |  |  |
| Sea lettuces |  |  |  |
| Abalone |  |  |  |

*Questions:*

1. How do the quadrat totals relate to the total number of each species along the entire transect?

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1. What are some of the limitations of quadrat sampling, particularly in relation to rare species?

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**Now you get to use actual quadrats in the site you have chosen:**

**ACTIVITY B: CALCULATING POPULATION DENSITY OF AN ORGANISM**

Used to calculate the population density of an organism (suitable for plants and for sedentary and slow moving animals):

*Procedure:*

1. Select the sample area in the ecosystem and mark it off.
2. Decide on and record the organisms to be studied.
3. Throw a small object over your shoulder to select a random sample point.
4. Place the quadrat at the random sample point.
5. Count and record the number of named organisms within the quadrat.
6. Repeat for a number of throws.
7. Calculate the average number of organisms per quadrat.
8. Calculate the number of population density of organisms (see calculation below).
9. Tabulate the results.
10. Transfer the results to a column graph (see next page).

*Results:*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|  | **Quadrat Throw** | | | | | | | | | | | | |
| **Organism name** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL No.** | **Average no. per Quadrat** | **Population**  **Density** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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**Population Density = Number of organism of a certain species**

**Total area of samples**

*Conclusion/comments:*

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**LINE AND BELT TRANSECTS:**

Line transects are taken along a straight line. Can be of any length, but samples are taken at uniform intervals along it. These are used when the abiotic factors gradually vary, causing a change to the organisms living there. Examples include seashores (low to high tide), across streams, up hillsides etc…

A line transect can be used with a quadrant to sample in more detail, otherwise population estimates are limited to frequency. These are called belt transects. They are used to obtain a general ‘overview’ of an area before starting more detailed work with quadrats.

To conduct a quantitative study of organisms along a belt transect (suitable for areas where there is an obvious environmental gradient or an unequal distribution of organisms.

*Materials:*

Tape measure/rope (30m)

2 Tent pegs

Quadrat

Quadrat 30m tape/rope (transect)

0m 1m 2m 3m 4m 5m 6m

*Procedure:*

1. Select the sample area in the ecosystem and stretch the tape/rope across it.
2. Fix the tape/rope at either end with tent pegs so that it remains taut.
3. Decide on and record the organisms to be studied.
4. Place the quadrat at the 0m mark of the tape. Note and record the number of the named organisms in each quadrat.
5. Repeat at suitable intervals along the tape.
6. Tabulate the results.
7. Transfer the results to a column graph (see next page).

*Results:*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Quadrat Throw** | | | | | | | | | | | | |
| **Organism name** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **TOTAL No.** | **Average no. per Quadrat** | **Density (No. per m2)** |
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*Conclusion/comments:*

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**CAPTURE-RECAPTURE METHOD**

This is a method used in random sampling of moving animals. Changes in the abundance of animal populations are governed by four parameters – birth, death, immigration and emigration. Biologists require accurate information about the abundance of animals to make decisions about animal conservation.

Animals may be marked in different ways, e.g. leg bands for birds, ear tags or radio transmitters for mammals, fur clipping for small furry mammals such as mice, paint for shelled animals. Animals may be caught in a variety of ways depending on the animal, e.g. snails by direct search, beetles by pitfall traps, grasshoppers by sweep nets.

Capture-recapture studies are based on assumptions such as:

1. The sample is representative of the population. The trapping techniques used must not favour one group versus another, e.g. juveniles versus adults. All must have an equal chance of being caught.
2. The markers used do not affect the behaviour or the fate of the marked individuals. Markers must not increase the predation on the marked individuals.
3. Marked animals distribute themselves equally throughout the population so that marked and unmarked animals have an equal chance of being caught.
4. Markers are not lost. If this happens the population will appear to be more abundant than it really is.

Certain factors should be kept constant throughout the investigation such as the size of the capture-recapture area, the time of day and the collecting method used. The capture-recapture method is difficult to do in a school environment, so we will be completing the following activity which represents what would occur in a real-life capture-recapture study.

**Complete Activity 5.3: The Capture-Recapture Method on page 185 in your textbook. Complete your answers in the spaces provided below.**

|  |  |  |
| --- | --- | --- |
| **TRIAL** | **Number of Untagged Fish**  **(red beads)** | **Number of Tagged Fish**  **(yellow beads)** |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |
| 5 |  |  |
| 6 |  |  |
| 7 |  |  |
| 8 |  |  |
| 9 |  |  |
| 10 |  |  |
| AVERAGE: |  |  |

1. **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**FOCUS QUESTIONS**

*Refer to the activities in this manual and your textbook to assist you in answering these questions*

1. How would you estimate the size of a population of fast moving animals? Why?

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1. Using the formula on page 185 to calculate a population using the capture-recapture method, calculate the estimate population in the following example:

To protect the ever-decreasing crayfish population, conservation officers wished to estimate the current population, so that licences for the next year could be withheld. A sample of 350 young crayfish were caught, marked then released. A week later 274 were caught but only 92 were marked.

1. Estimate the population of crayfish.
2. Is this number a true indication of the crayfish population in this area? Explain.

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1. What are some of the things that may have happened to the original marked sample?

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1. Using the population density formula you learnt in quadrats, calculate the density of the organisms in the examples on the next page:

Three students performed a quadrat study on the oval at their school. These are their results:

|  |  |  |
| --- | --- | --- |
| **Quadrat Numbers** | **Number of Plant A** | **Number of Plant B** |
| 1 | 4 | 2 |
| 2 | 3 | 1 |
| 3 | 0 | 0 |
| 4 | 5 | 0 |
| 5 | 6 | 2 |
| 6 | 6 | 8 |
| 7 | 7 | 2 |
| 8 | 5 | 4 |
| 9 | 3 | 0 |
| 10 | 1 | 0 |
| 11 | 16 | 15 |
| 12 | 12 | 10 |
| 13 | 8 | 10 |
| 14 | 3 | 0 |
| 15 | 16 | 1 |
| 16 | 4 | 5 |
| 17 | 3 | 2 |
| 18 | 8 | 6 |
| 19 | 4 | 8 |
| 20 | 10 | 0 |

1. Calculate the total numbers of Plant A and Plant B in the quadrat areas sampled.
2. If the quadrats they used were 1m x 1m, calculate the total area they sampled.
3. Calculate the density of Plant A and Plant B. Write your answer as the number of plants per m2.